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WAKE CHARACTERISTICS STUDIES

Chester E. Grosch, et al

Ocean and Atmospheric Science, Incorporated

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TR 72-106

Final Report

Wake Characteristics Studies

by

C. E. Grosch, B. Harris, E. Y. T. Kuo, and R. Gershman

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13. ABSTRACT

The work effort under the contract is briefly summarized. Details are covered in the list of technical reports.

Three general areas related to nonacoustic detection were investigated:

1. Diffusion from the wake
2. Signal processing
3. Analysis of oceanographic experiments

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Program Code Number:	1E20
Contract Number:	N00014-72-C-0127
Principal Investigator and Phone Number:	Dr. Chester E. Grosch 914-693-9001
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Amount of Contract:	$104,728.00
Scientific Officer:	Director, Fluid Dynamics Program Mathematical and Information Sciences Division Office of Naval Research Department of the Navy 800 North Quincy Street Arlington, Virginia 22217
Short Title of Work:	Wake Diffusion Modeling

This research was supported by the Advanced Research Projects Agency of the Department of Defense and was monitored by ONR under Contract No. N00014-72-C-0127.

This is the final report under Contract No. N00014-72-C-0127 for the Office of Naval Research, sponsored by Advanced Research Projects Agency (ARPA Order No. 1910), by Ocean & Atmospheric Science, Inc. The work effort is briefly summarized below. Details are covered in the attached list of technical reports. Three general areas related to nonacoustic detection were investigated:

1. Diffusion from the wake
2. Signal processing
3. Analysis of oceanographic experiments

The basic objective of the first task was to study the diffusion of a passive scalar in the turbulent wake of a self-propelled body, and out of that wake under the influence of the ocean turbulence. In order to accomplish this task, a number of detailed calculations were carried out. The late stages of the diffusion were modeled by calculating the diffusion from a well-mixed and essentially non-turbulent wake under the influence of the background ocean turbulence. In order for this study to be meaningful, it was necessary to examine the validity of various diffusion models and to examine the related data on diffusion coefficients. The existing knowledge of oceanographic diffusion processes and data on measured diffusion coefficients in the ocean (both near surface and at intermediate depths) were reviewed. Based on the existing diffusion data, related turbulence data for the oceans, and basic turbulence theory, it was possible

to obtain reliable estimates of the ocean diffusion coefficients at intermediate depths, which are the region of interest. Finally, the diffusion in the early wake was modeled with a point source. Using this model, equations were derived which allowed the calculation of the concentration of the scalar through the stage of wake growth and subsequent collapse and deformation.

The second task was that of signal processing. Several theories have evolved about how the passage of a submerged object can alter the surface wave power spectra. The evaluation carried out under this contract is of a system and signal processor which examines the consequent alterations in the directional wave power spectrum and uses the maximum likelihood ratio to decide if such passage has occurred.

The third task, oceanographic experiment analysis, was combined of several subtasks. These included a critical review of available methods for measuring short surface gravity waves and capillary waves, an analysis of the potential for using the acoustic techniques to probe the fine structure of the thermocline, and a review of the state of knowledge of the thermal structure of the air-sea interface.

The detailed technical discussion of the results of this research is contained in the technical reports, Table I, prepared under this contract.

TABLE I

Technical Reports Prepared Under Contract N00014-72-C-0127

OAS Report No.	Title and Author (s)
71-057	Equalization of the Thermistor Response B. Harris
71-062	Preliminary Evaluation of an Active Sonar System for Measuring the Fine Structure of the Thermocline. B. Harris
72-065	Some Comments on the Modeling of the Collapsing Wake. E. Y. T. Kuo and C. E. Grosch
72-070	Preliminary Analysis of Using a Vertical Array Sonar System to Measure the Fine Structure of the Thermocline. B. Harris and R. M. Chervin
72-073	Some Comments on the Modeling of the Turbulent Wake of a Self-Propelled Body in a Stratified Fluid. E. Y. T. Kuo and C. E. Grosch
72-083	Signal Processing of Ocean Surface Effects (Secret) B. Harris and R. Gershman
72-084	Survey and Comments on Methods for Measuring the Spectrum of Ocean Surface, Short Wavelength Gravity Waves. E. Y. T. Kuo
72-089	Bi-mode Hypothesis and Horizontal Oceanic Turbulent Diffusion I. Theoretical Predictions E. Y. T. Kuo
72-092	Turbulent Diffusion in a Stratified Fluid with Application to the Ocean. C. E. Grosch

Table I (continued)

OAS Report No.	Title and Author (s)
72-093	A Simple Diffusion Model in a Collapsing Wake. E. Y. T. Kuo
72-105	Thermal Structure of the Air-Sea Interface. C. E. Grosch, E. Y. T. Kuo and M. Bernstein
72-106	Final Report: Wake Characteristics Studies. C. E. Grosch, B. Harris, E. Y. T. Kuo and R. Gershman